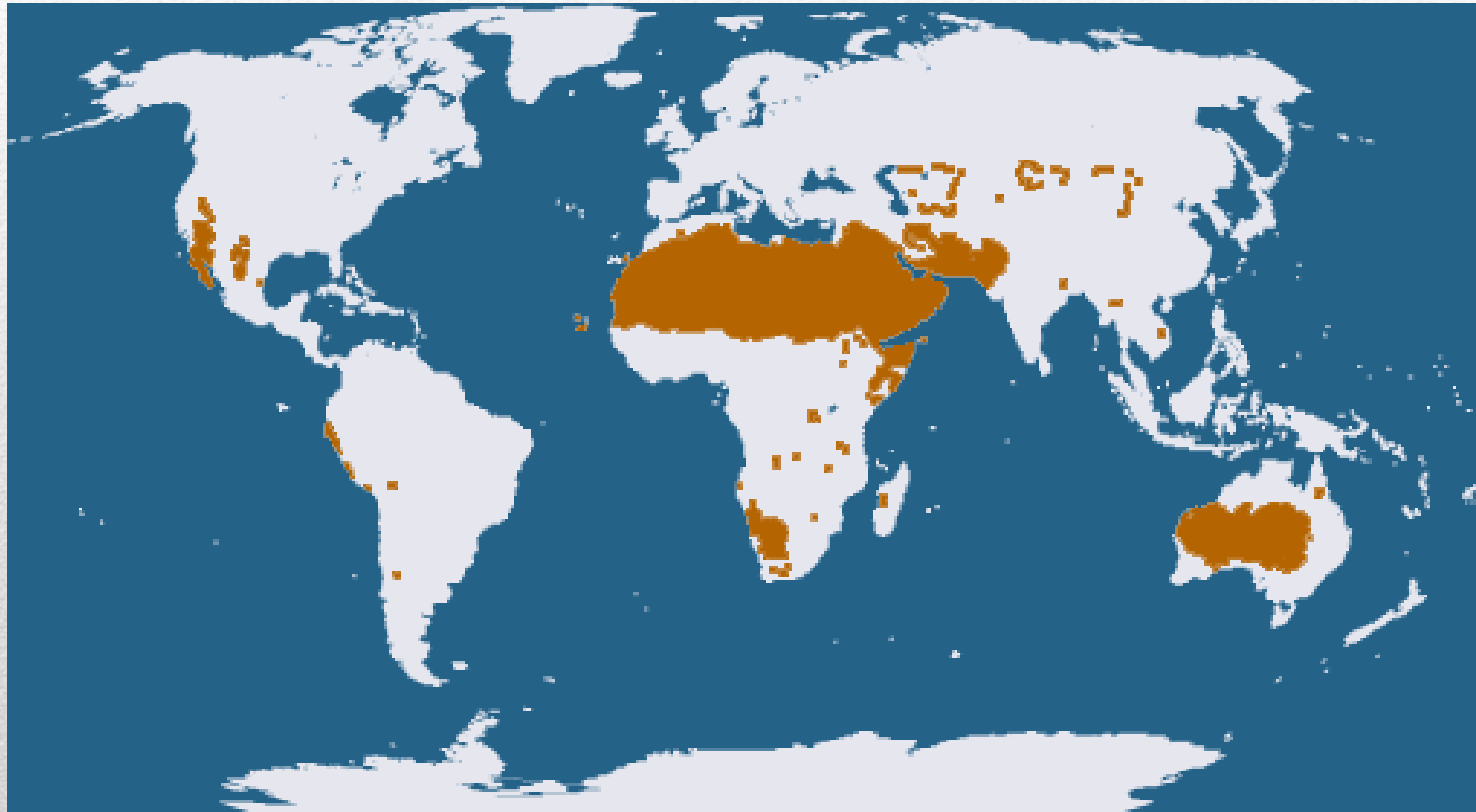


# **Topography of Arid Lands**

## **Chapter 18**

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# Deserts of the Worlds





# Specialized Environment

- Special Conditions in Deserts
    - **Weathering**- mostly mechanical
    - **Different Soil and Regolith**- little soil or regolith exposing bedrock to erosion
    - **Soil Creep** – minor in desert slopes
    - **Impermeable Surfaces** - most surfaces are impermeable to percolating water
-

# Special Conditions in Deserts

- **Sand** – Deserts have lots of sand
    - Sand cover allows water to infiltrate- inhibits drainage via streams or overflow
    - Sand is readily moved by heavy rains
    - Sand can be shifted and shaped by the wind
  - **Rainfall**- much of the rainfall in the desert areas is intense, often coming from convective thunderstorms.
  - **Fluvial Deposition** – all streams are ephemeral- effective agents of erosion
  - **Wind** – most deserts don't have wind as a large effect- some have high winds, but not all
  - **Basins of Interior Drainage** - areas of many drainages that never make it to the ocean - such as the Great Basin
  - **Vegetation** – perhaps the most important condition- the lack of vegetation has the effect on the topography
-



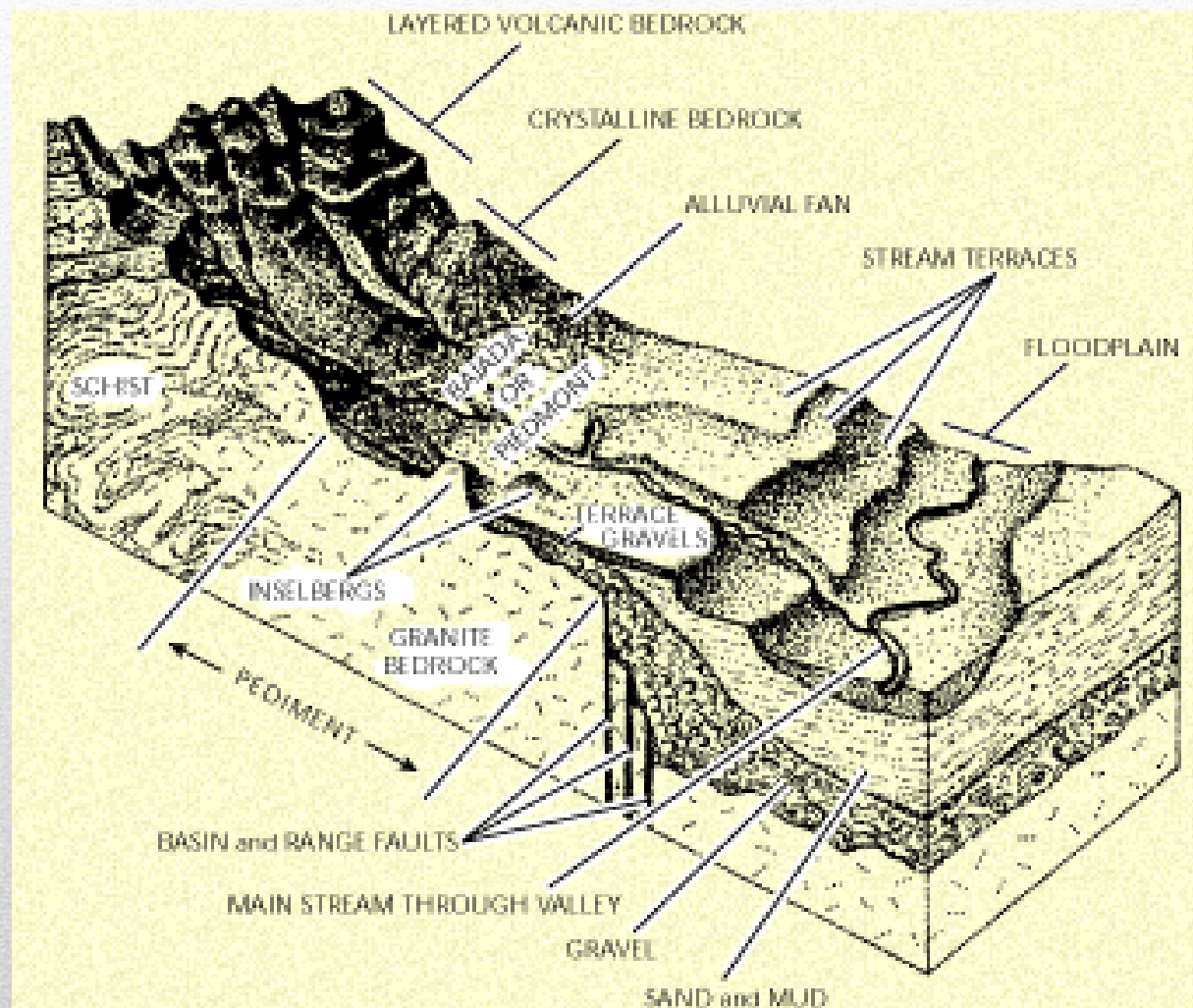
# Water in Arid Regions

- Running water is by far the most important external agent of landform development
  - Surface Water in the desert
    - Exotic Streams - permanent streams in dry lands (where the water comes from adjacent mountains or wetter areas) and have sufficient volume to survive to the ocean- examples Colorado River or Nile River
    - Desert Lakes – dry lake beds – called playas or salines if there is a large amount of salt present
      - Playas - are the flattest, most level of all landforms
      - Saline lakes – permanent lakes in desert areas, Great Salt Lake a good example
-

# Fluvial Erosion in Arid Lands

- **Differential Erosion** - whenever a land surface erodes, variations in rock type and structure produce differences in the slope and shape of the resulting land form.
    - Results – cliffs, pinnacles, spires
  - **Residential Erosional Surfaces** - steep-sided mountains called inselbergs- these resemble “island mountains”
    - A type of **inselberg** is called a **bornhardt**.
  - **Desert Stream Channels** - normally dry beds of ephemeral streams
    - Called arroyos, gullies, washes or coulees
-





# Fluvial Deposition in Arid Lands

- **Piedmont** - generic term meaning any zone at the foot of a mountain range
  - **Piedmont Zone** – one of the most prominent area of fluvial deposition
  - **Piedmont Angle** - a pronounced change in the angle of slope at the mountain base
-



# Characteristics of Desert Surfaces

- **Erg** – a large area covered with loose sand generally arranged in some sort of dune formation by the wind
- **Reg** – Stony deserts – tight covering of coarse gravel pebbles, and/or boulders removed by wind and water sometimes called desert pavement
- **Desert Varnish** – dark shiny coating consisting mostly of iron and manganese oxides that forms on the surface of pebbles, stones, and larger outcrops of rock
- **Hamada – Barren Bedrock**- a barren surface of consolidated material- usually consists of exposed bedrock





# The Work of the Wind

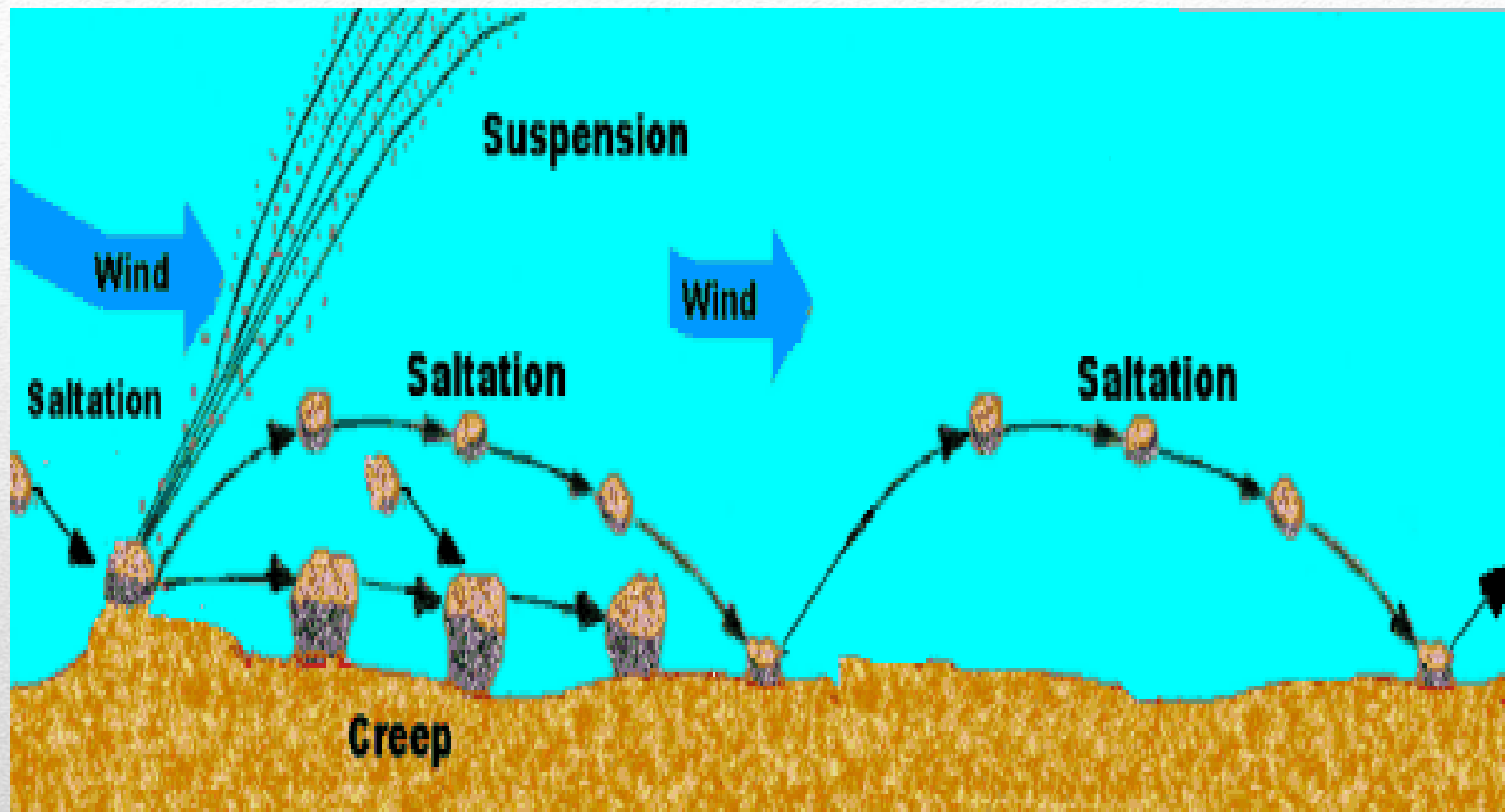
- **Aeolian Processes** – those related to wind action
    - **Aeolian Erosion**
      - **Deflation**- the shifting of loose particles as a result of their being blown either through the air or along the ground
      - **Abrasion**- the same as fluvial abrasion except that the Aeolian is less effective – Require “tools” in the form of airborne sand and dust particles – Doesn’t construct- merely sculptures what is already there
-



# Aeolian Transportation

- Rock material carried by the wind much like in the water but less effectively
- The is done by “saltation” and “traction”
  - Large particles move by traction
  - Small particles are moved by saltation
  - Entire surfaces moves in a “creep” not like the soil creep



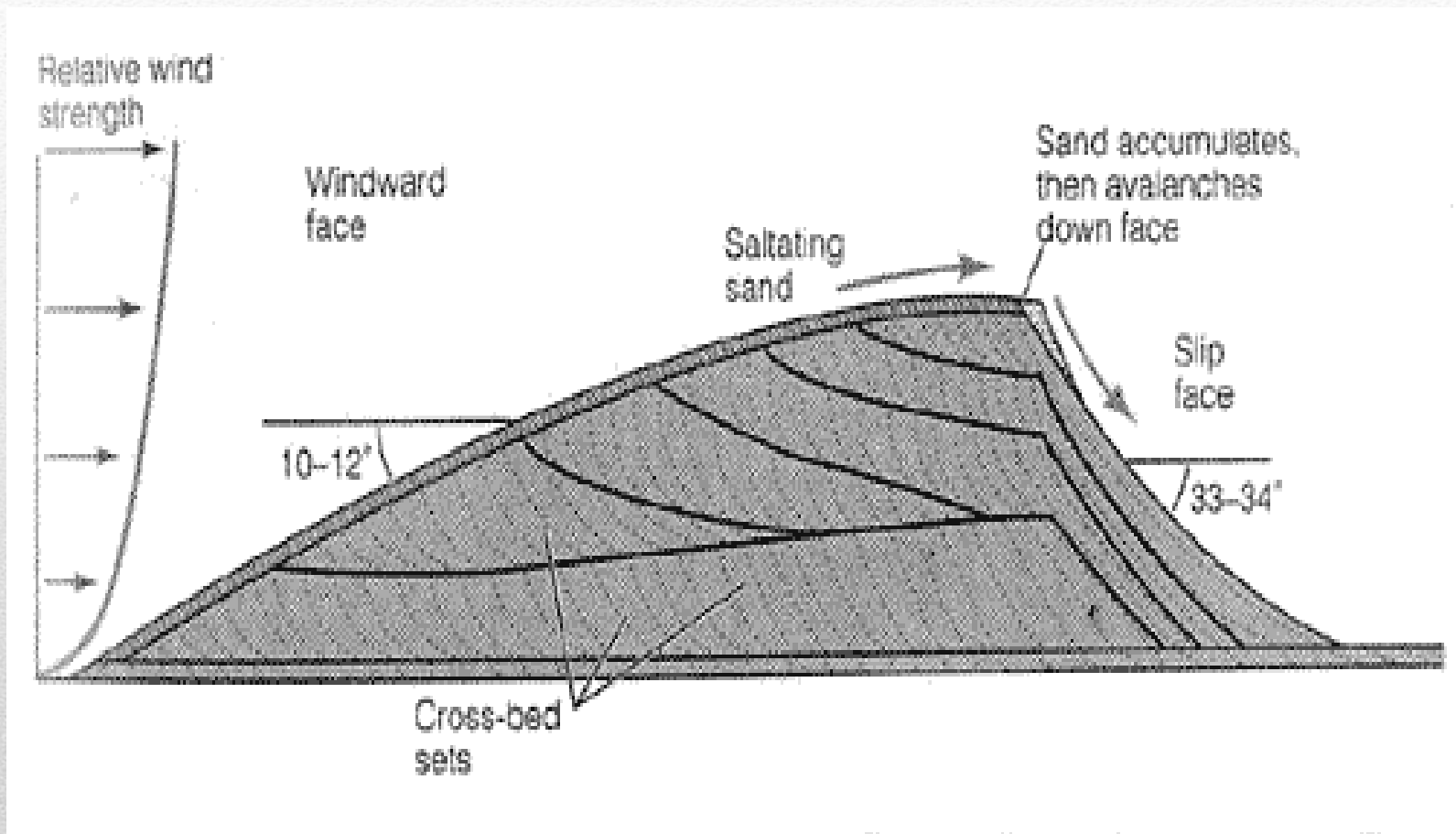




# Aeolian Deposition

- Sand and Dust Moved by Wind eventually deposited into sand plains or sand dunes
- Desert Sand Dunes – composed entirely of unanchored sand that is mostly uniform grains of quartz - three kinds of dune patterns









# Kinds of Dunes

- **Barchans-** best known- occurs as an individual dune migrating across a non-sandy surface
- **Crescent Shaped-** with horns point down wind
- Form where strong winds blow consistently and can be the fastest moving





# Kinds of Dunes

- Transverse – also crescent shaped but less uniform
- Occur where the supply of sand is much greater than the area where Barchans are found
- All crests are perpendicular



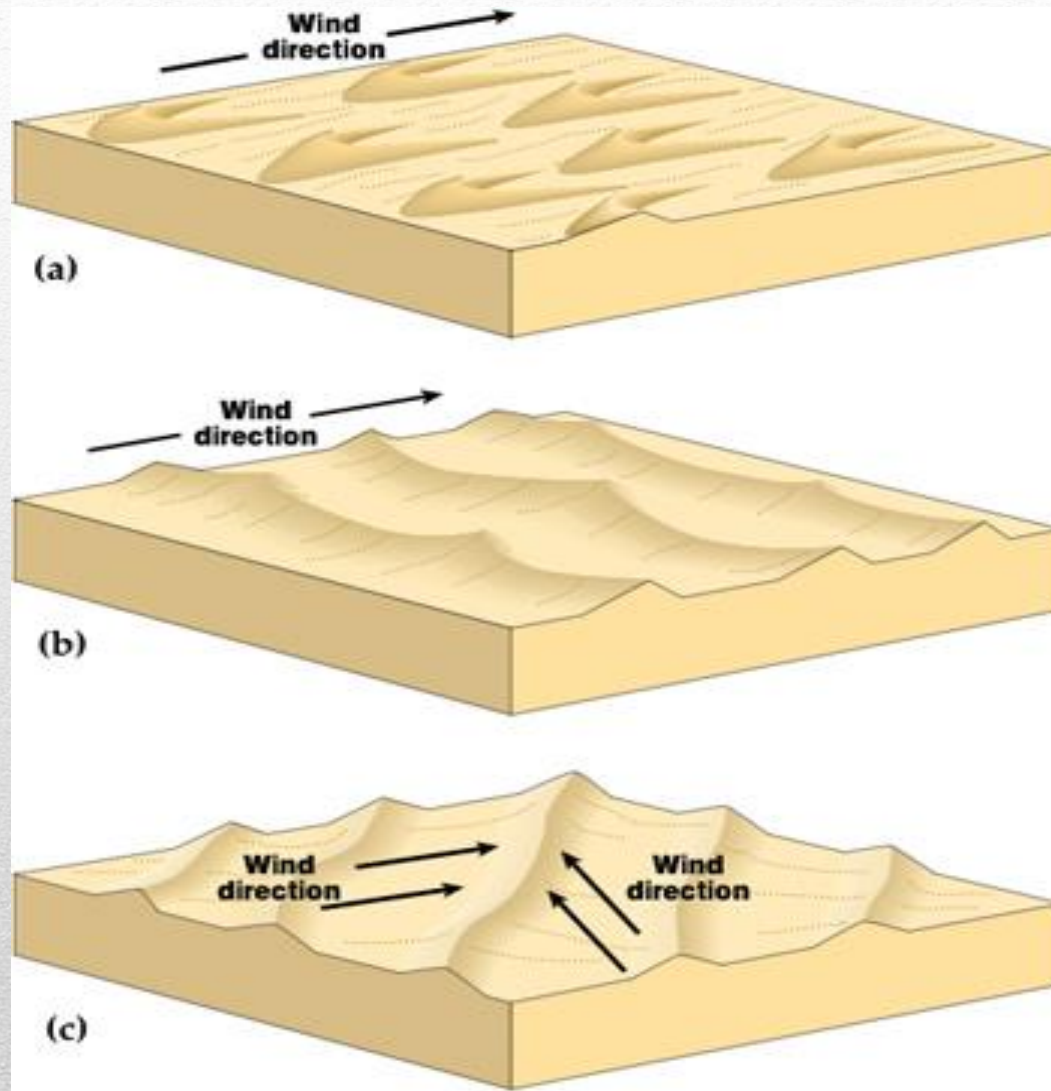


# Kinds of Dunes

- Seifs – long narrow dunes – usually occur in multiplicity and in a generally parallel arrangement
- - Origins are not well understood
  - Rare in American deserts







# Kinds of Dunes

- Coastal Dunes
  - Wind active in dune formation along many stretches of ocean and lake shores
- Loess – a form of Aeolian deposit not associated with dry lands
  - A wind- deposited silt that is fine grained, calcareous and usually buff colored
  - Lacks horizontal stratification
  - Vertical durability





# **Two Characteristics Desert Landform Assemblages**

Most common desert landform is a  
mountain or mountain range flanked  
by plains

**Basin and Range Terrain**

**Mesa and Scarp Terrain**

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# Basin-and-Range Terrain

- Land largely without external drainage
  - Has few exotic rivers flowing through or out of the region
  - **Three principal features** – ranges, piedmont zones, and basins
    - Ranges – dominate the horizons
    - Prevalence of steep and rocky slopes
    - Ridge crests & peaks are usually sharp steep cliffs
    - The ranges have been eroding for a long time
-



# Basin-and-Range Terrain

- **The Piedmont Zone**
    - At the base of the ranges, a sharp break in the slope ( the piedmont angle)
    - Transition area from slopes of ranges to the near flatness of the basin
  - **Alluvial Fan** - found at the mouth of canyons where streams empty and deposit their debris
  - **Bajada or Piedmont Alluvial Plain-** where alluvial fans build up and join together
-



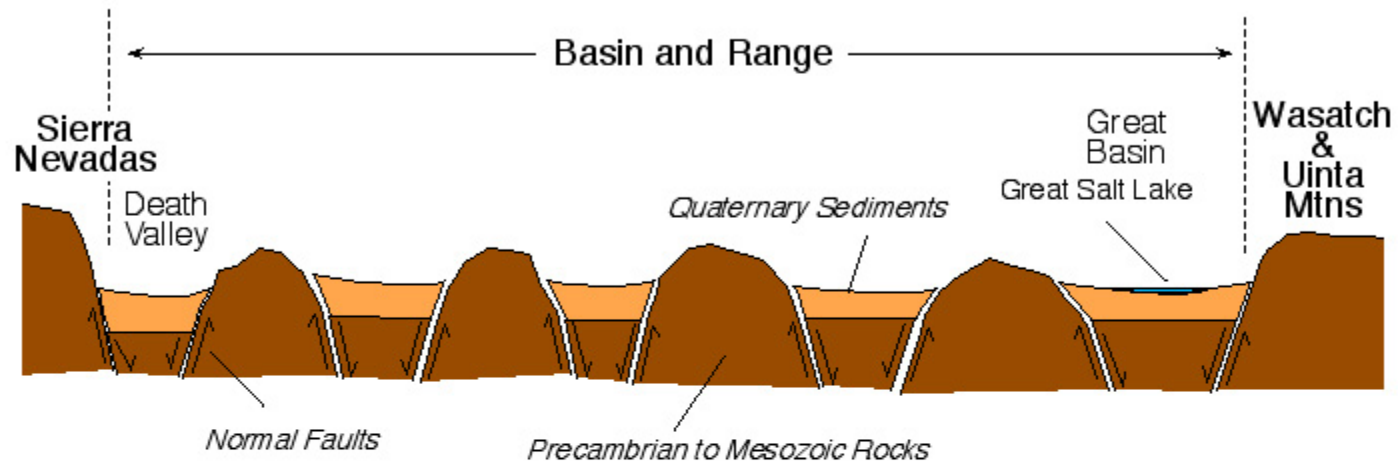




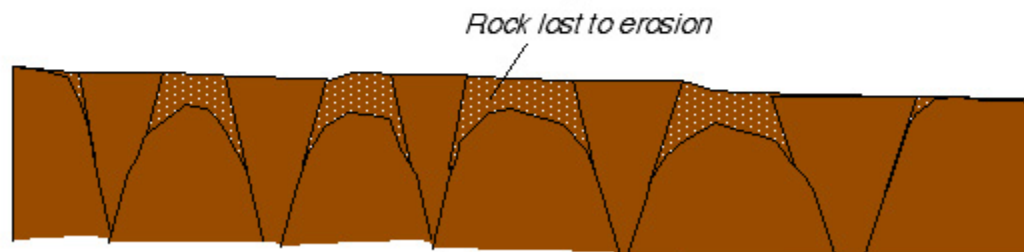
# Basin-and-Range Terrain

- Beyond the piedmont is the flattish floor of the basin
    - Low point is usually in a playa
    - Drainage channels across the basin floor sometimes clear cut but more often shallow and ill defined, frequently disappearing before reaching the low point
    - Salt accumulations are commonplace
    - Sometimes the water runs into playa lakes
      - Extensive but shallow
      - Persist for only a few days or weeks
      - Basin floor is covered with very fine-grained material
        - Death Valley is example of Basin and Range Terrain
-

## Simplified and schematic geologic cross-section of the Basin and Range



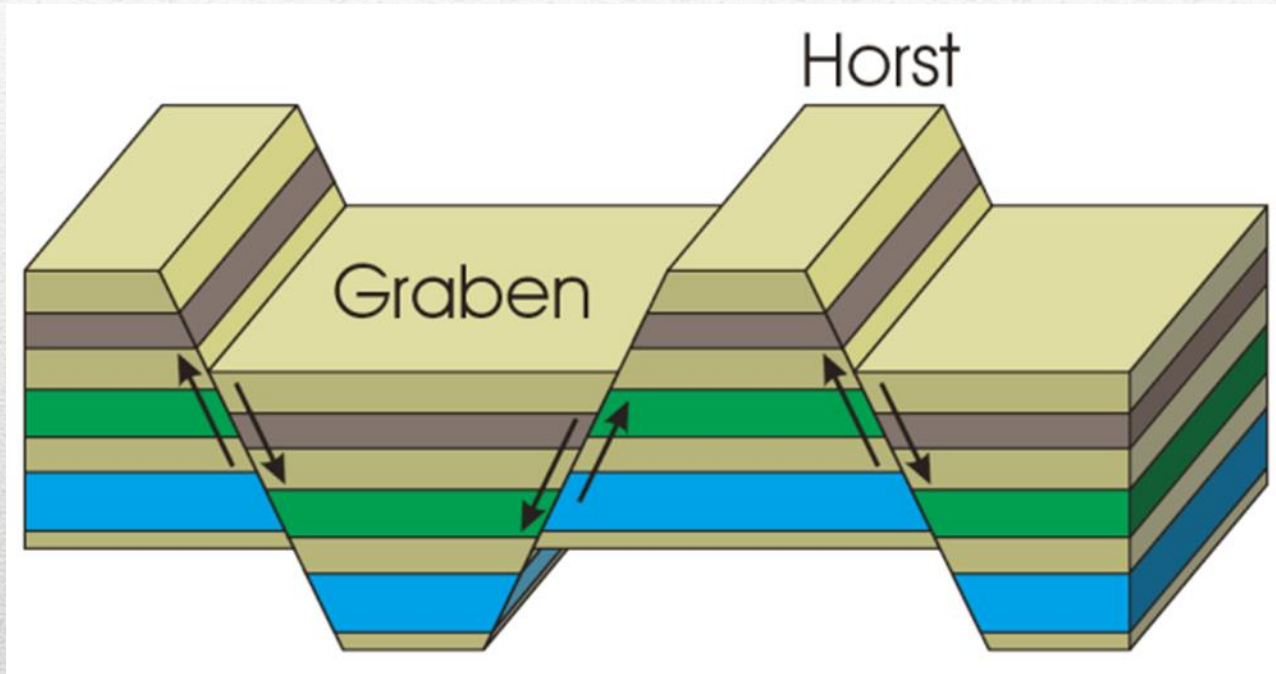
Before extension to make the basins and ranges:

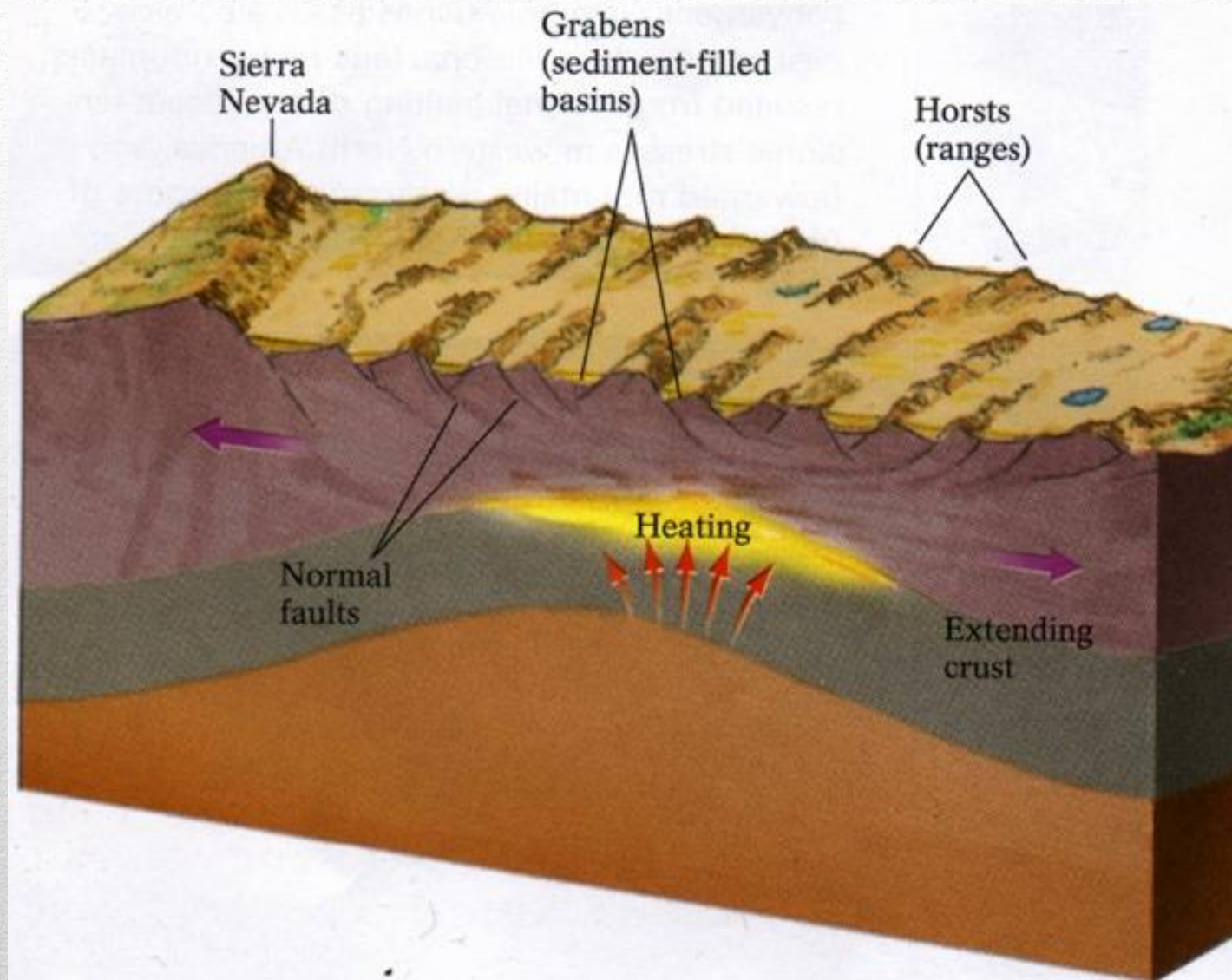


LBR 4/2002

Warning: This diagram is an extreme simplification for an introductory geology class for non-majors. There are many more basins and ranges than are shown here, and this would not be a cross-section along a straight line. The geology is considerably more complex than is shown.









# Mesa and Scarp Terrain

- Mesa (Table)
  - Scarp (Short for escarpment)
  - Normally associated with horizontal sediment strata
  - Differential erosion shows up prominently
  - Resistant strata weather and erode into mesas or scarps
    - The more easily eroded strata yield the gentler the inclined slope
  - Much of the undermining done by a process called sapping- groundwater seeps and trickles out of the scarp face, eroding fine particles and weathering the cohesion of the face
-

# Mesa and Scarp Terrain

- Types of topographic features of mesa and scarp terrain
  - **Plateau**- erosional platform- bounded on one or more sides by a prominent escarpment
  - **Butte or Mesa** – smaller topographical features formed by mass wasting.
  - **Pinnacle- or pillar**, a final spire of resistance.
- Examples of mesa and scarp terrain
  - Badlands of Utah or Wyoming
  - Arches and Natural Bridges of Utah

